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ABSTRACT

Elementary education majors (n=22) in a science methods course at a small liberal arts college in the U.S. Midwest were asked to write a paper about science in their own lives. Based upon their writings, the students were categorized according to the five ways of knowing described by Belenky, Clinchy, Goldberger, and Tarule: silence, received, subjective, procedural, or constructed knowledge. The largest category was subjective knowers and was comprised of only female students. The implications for these subjective knowers involve in accessibility to formal scientific knowledge and expertise. These women were unable to connect to the science they were learning in their classsrooms and so turned to their own personal experience upon which they could depend. The large number of subjective knowers and the lack of formal scientific information as an ultimate source of knowledge seen in this study seem to indicate that many students are not making the connection between their science classes and everyday lives. (MKR)

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EXAMINING THE SIGNIFICANCE OF SCIENCE IN THE LIVES OF PROSPECTIVE ELEMENTARY TEACHERS

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This study arose from an assignment given to elementary education majors in an elementary science teaching methods course. Many students began the course with a frank dislike and disinterest in science for themselves personally even though they realized and accepted the obligation of teaching science to their elementary students.

I was disturbed by the notion that these students felt they could do an adequate job teaching science when they had no interest or personal connection to it themselves. Yet I was not surprised at their personal feelings about science. Feminist researchers (Harding, 1986; Keller, 1985) have written about the masculinization of science and the subsequent alienation and exclusion of science for women. Hubbard (1988) talked about the "insider/outsider" perspectives of science and claimed that, on one level, "'inside' is the white, male power structure, 'outside' are the excluded-women, people of color and especially women of color, poor people, immigrants" (p. 19). Rosser (1990) reported on the fragmentation of academic science for college students and the difficulties of making "personal and community" connections to science. In looking specifically at elementary preservice teachers, Abell and Smith (1994) found that these students did not stress the social aspects of science.

Considering the experiences these students may have had with traditional science classes, I hoped we could explore more personal and social ways of knowing science. I asked the students to write a paper about science in their own lives with the hope that once they took a thoughtful look at their own lives they would see that science was an integral part that they had

not previously recognized. Perhaps they might enlarge or revise their own visions of science to fit and support their own personal needs and interests.

I was surprised when reading the papers at the enthusiasm and conviction the students expressed in their writing. Though they followed a variety of paths, all students wrote earnestly about the role of science in their lives. Certainly they had the motivation of pleasing their teacher, but many of the stories seemed to indicate a deeper understanding and connection to science that contradicted their statements at the beginning of the course.

As I was studying the papers, many features of their writing struck me in surprising and poignant ways. I decided to let these characteristic features guide my analysis.

Student Makeup

There were 22 students in the elementary science methods course which was offered at a small liberal arts college in the U.S. Midwest. The student body at the college was largely from a middle class background. Most of the students in the course were at the sophomore level with approximately one-third of the members at the junior level. All were entered in a program to receive elementary teaching certification. Most students were English majors followed by history and math. Only one student was a science (geology) major. Ethnic origin was principally European-American with one Korean student who had received her pre-college education in international schools in South Korea. Eighteen of the students were female, and four were male.

Data Analysis

Following a preliminary examination of the data, I decided an important analysis was the ways of knowing framework developed by Belenky, et al (1986). A strong emphasis on how

students knew the scientific information they described stood out in their writing. Other aspects of the students' writing seemed to be important in support or further development of their ways of knowing. These aspects were also included in the analysis to give a more complete picture of their ways of knowing. The characteristics included students' ultimate sources of knowledge, voice and personal agendas.

Belenky, et al (1986) described five ways of knowing: silence, received, subjective, procedural or constructed knowledge. Though they analyzed women's ways of knowing only, they state that the construction may apply to men's ways of knowing in particular instances, also. Some of the ways they discussed have commonalities with the framework set up by Perry (1970) whose studies focused on male participants. Since the student population in this study was primarily female and the Belenky, et al framework had latitude for the inclusion of male ways of knowing, it seemed the most appropriate construction to use.

Briefly, Belenky, et al characterized the five ways of knowing as follows. Silent women have no voice. In complete obedience to authority, they are paralyzed from communicating their thoughts and "unable to find meaning in the words of others".

Women who receive knowledge rely on authorities to give them the information they need. These women see the power of knowledge and are willing recipients of what others tell them. They do not, however, see power in their own thinking.

Subjective knowledge can be viewed as the opposite of received knowledge. Women who use subjective knowledge are distrustful of authority and instead rely on their own personal, intuitive knowledge and feelings. They can only trust that which comes from within.

Procedural knowers are similar to received knowers in that they do not believe in personal intuition or feelings. They see the utility and rationality in authoritarian knowledge.

They go beyond receiving and are able to apply the knowledge they have gained.

Constructed knowledge is in a sense an integration of procedural and subjective knowledge. These women see power in their own personal thinking and in the knowledge of experts. They are able to use the two together to "construct" new meaning for any particular context.

In looking at students' ways of knowing, an important accompaniment and clarifier of their knowing was where their knowledge arose. This notion of a source of knowledge originated from Posner and Strike's development of a conceptual ecology (1982, 1992). The authors postulated a variety of features which make up the understanding a student has of a scientific concept. The ecology includes "anomalies, analogies and metaphors, epistemological commitments, metaphysical beliefs and concepts, other knowledge, motives and goals, and institutional and social sources". Looking at the students' sources of knowledge in this study was one facet of a complex individual ecology. This aspect was chosen because of its intimate connection to ways of knowing.

Most students indicated a number of sources from which they learned, but usually one source stood out as being the foundation of the students' understanding. This source is referred to as the ultimate source of knowledge and will be the focus of this part of the study.

Students expressed themselves in a variety of ways, but each carried a definite character that I will refer to as voice. Voice seemed to be a critical feature that expressed their personal expression, attitude and commitment. In this way it was highly connected to their ways of knowing.

Students were very emphatic about why their chosen topic was important to them. Their

personal agendas were, therefore, also studied in the hope of gaining some understanding why certain aspects of science were significant to them personally.

Silent Knowers

One student was categorized as a silent knower. She wrote about tobacco use and the need for nonsmoking sections in international locations. As a silent knower she was uncertain of the origins of her knowledge.

> I am not sure how I came about with this knowledge. I know I did not sit down and study it nor did I do some research on it for a paper. I also know that I did not do any debates or discussions on it. I presume, I came about with this knowledge since many people around me, whether it be personal friends or stranger, smoke and I am aware of it.

From the excerpt it appeared that her ultimate source of knowledge was personal experience through being exposed to tobacco smoke from those around her. The voice this student used was powerless. She was aware of the dangers of tobacco smoke exposure but was unable to speak up and protect herself from those around her smoking even when she had this right in a nonsmoking section. She discussed the impact her upbringing in a Korean family had on her behavior.

> I guess I don't speak up to people who smoke where they are not supposed to smoke, is because of my culture. In my culture, you do not tell an elder what to do and what not to do, especially an elder who you do not know.

This student's agenda was concerned with personal responsibility. She worried about the effects of smoking on herself, wished people would stop smoking around her but did not have the power to stop them herself. She expressed the beginnings of social responsibility but was uncertain that she could do anything to help others.

Received Knowers

Four of the students in the study were classified as received knowers. All of these

students wrote about medically related topics. (Medical topics represented the vast majority of student writing, 16 out of the 22 students.) The students discussed knowledge that they had gained from sources outside of themselves. Personal intuition and feelings were minimally expressed or absent.

Characteristic of received knowledge these students cited outside sources as their principal bases of information. What was somewhat surprising about this group was that the ultimate sources of knowledge were not the expected science authorities of class texts or science teachers. Instead popular media such as magazines, talk and news shows were cited as the ultimate sources of knowledge for two students writing about AIDS. In discussing their grandparents' illnesses, the other two students relied on information gathered from family members. Two of the students did talk about classes or teachers contributing to their knowledge. However, the majority of their topic depiction was broadly descriptive and appeared to arise more from the popular media sources.

The student voices were closely aligned with their sources of knowledge. Those citing popular media were tentative and not completely confident about their knowledge. They both claimed to need more information and indicated that additional knowledge would strengthen their positions. The two students who described grandparent illnesses wrote in rational, objective voices boosted by detailed elaboration of medical facts concerning the conditions. The feigned "scientific" voices seemed a somewhat forced effort that did not completely mask the pain which was still evident in their personal suffering.

> Although I wasn't hurt by this experience, I did learn about dealing with the trauma that both the alcoholic and family goes through when faced with the disease. In addition to my scientific knowledge of the disease, I also gained a greater understanding of the loss of pride any alcoholic goes through and the
> ...

sense of desperation they must endure everyday.

Agendas also matched the topic descriptions. The students writing about AIDS discussed social responsibility. They expressed the need to educate ourselves and others in order to prevent the spread of this fatal disease.

> I feel that my knowledge of AIDS is good to know, not only for myself but for society as well. One can never know enough about this, and if I can put my two cents worth in, I will. If I can inform and help just one person with what I know, it will be all worth while.

The other two had similar but more locally defined agendas. They felt a family responsibility to understand disease in order to effectively assist the ill and supporting family members.

Subjective Knowers

Seven students wrote about topics they knew subjectively. Topics included medicine, the environment and ethics. These students rejected authority and depended on their own personal knowledge and feelings.

All seven students described their own personal experiences as the ultimate sources of their knowledge. One student spoke of the frustration she felt with the lack of knowledge by the scientific community in explaining her grandfather's Alzheimer's disease. She saw dependence on her own personal abilities as the only sound alternative.

> The scariest thing was our ignorance on the subject of Alzheimer's. It had just been discover a few years before and scientists hadn't figured out what caused it or what could cure it. Most of what is known about it is what can be discovered by observing someone with this problem. That is where most of my knowledge about it came from.

Students pleaded their claims with emotional and passionate voices. The voices were absent of rationality and often distrustful of science. In discussing recycling one student conveyed the desperation of our present global condition.

> I view recycling as an issue everyone should be concerning themselves with because if something is not done soon, our planet Earth is going to die...I often ask myself why would anyone not do what ever they could to keep this unnecessary tragedy from happening!

All student agendas were about responsibility ranging from personal to family to society depending on the topic discussed. One student talked about stress in her life and the need to help herself. Three students discussed family members' illnesses and wanted to find ways to help the ill and the rest of the family. Their agendas were similar to received knowers discussing family illness. Three talked of issues of greater global concern, and they had agendas of social responsibility.

Procedural Knowers

Five student essays were evaluated to be representative of procedural knowing. While the preceding categories had all female subjects, two males and three females were categorized as procedural knowers. Three discussed medical topics, and two addressed environmental issues. These students had gained knowledge from authorities and were able to apply it to particular situations. Their knowledge, however, did not contain any influence from their personal intuition or feelings.

As with received knowers, these students attained their knowledge from authoritative sources outside of themselves. Like the received knowers, the authoritative sources were usually not the traditional science authorities of text or teacher. Two students cited formal science authorities that they had encountered through their own personal research. One student gained her knowledge from discussions and debates with other students. One student learned from her father, and the other learned primarily from her job.

All five voices were objective, rational and confident of their knowledge. They felt

certain that the utilization of scientific knowledge was very powerful for their own purposes and in convincing others of their positions. One student pointed to her confidence and ability to use the facts about AIDS.

> I feel confident in my knowledge of AIDS, at how to protect myself and in answering questions others have. Reading the facts about AIDS gave me the basics in my head, but talking about them put it solidly into my brain.

All five students had agendas dealing with some form of human responsibility ranging from personal to family to social. The topic's proximity to themselves or their family was the determining factor on how close they felt their responsibility to be. In one student's discussion of AIDS he described a personal and social responsibility.

> I use this information about aids that I have learned recently and during my earlier education to live life. I know that I must be careful about what is out there, and that if I'm not careful, I have just as much of a chance of catching a life threatening disease as the next person.
>
> I think it is very important to know as much about the HIV virus as possible, specially since I will be in the career of education. I'm sure that during some part of my life I will come across students or faculty that have the virus. And educating children about the virus at an early age is one way that we can help put a cap on this life threatening problem.

Constructive Knowers

Five students were categorized as constructive knowers who integrated personal knowledge and feelings with expert information to create new knowledge to fit the contexts they were describing. Topics ranged from medical issues to ethics and technology. There were three females and two males in this group. Only one male student wrote about technology.

Sources of knowledge were some combination of personal experience and formal scientific knowledge. In all cases personal experience appeared to be the ultimate source of knowledge, but outside expertise also figured prominently in their conceptual ecology. Four of

the five students mentioned classrooms or texts as significant sources of knowledge. One student indicated the importance of classroom knowledge to her learning process.

> This information was gathered through my biology courses in high school and college. I initially became interested when we typed our blood in my ninth grade biology course. I knew my mother was O-positive and that my father was B-positive. I was surprised when my blood type was O-negative. My biology teacher told me to go back and find out my grandparents' blood types and see if there was any negatives. It turns out that my paternal grandmother was O-negative also. My teacher also made sure that I understood that someone on my mother's side also had to be negative, since it was a recessive trait.

In reading this excerpt and emphasized in other parts of her paper, this student became interested in formal knowledge because she could connect it to her own life. Also, her science teachers expressed a personal interest in her and encouraged and supported her questioning.

All five students expressed their knowledge in rational and confident voices that utilized scientific information, but they also balanced this with personal experience and concern. They saw a meaningful connection between their formal knowledge and personal intuition.

Similarly to other categories, three students articulated agendas of human responsibility again ranging from personal to family to social. For the first time two students had agendas dealing with personal and social utility of science. One student who discussed technology in sports described how he could use his knowledge personally and in teaching.

> To me the knowledge is important for a bunch of reasons. My safety, my understanding of each sport so that I can coach and teach others, and for my entertainment. When someone says, "don't a lot of people die racing?" then I can explain to them why a lot of people don't. I can feel safer and so can every one else participating in football, basketball, or any other sport when they know they have solid equipment behind them.

Implications

While the students' ways of knowing were spread among all of the categories in Belenky,

et al's framework, a few trends are of interest. The largest category was subjective knowers and was comprised of only female students. Tannen (1990) discussed gender differences in language styles that correlates with the different ways of knowing.

> *Intimacy* is key in a world of connection where individuals negotiate complex networks of friendship, minimize differences, try to reach consensus, and avoid the appearance of superiority, which would highlight differences. In a world of status, *independence* is key, because a primary means of establishing status is to tell others what to do, and taking orders is a marker of low status. Though all humans need both intimacy and independence, women tend to focus on the first and men on the second (p. 26).

If one thinks of intimacy as characteristic of individuals with personal knowledge and independence as characteristic of outside knowledge, one can see gender-based patterns within the study. Many women in the study had personal experience as an ultimate source of knowledge (one silent knower, seven subjective knowers, three constructive knowers), while the men were in categories with all or partial outside knowledge (two procedural knowers, two constructive knowers).

The implications for the subjective knowers involve inaccessibility to formal scientific knowledge and expertise. These women were unable to connect to the science they were learning in their classrooms and so turned to their own personal experience upon which they could depend. Noddings (1992) proposed that we might envision schools in alternate ways. She suggested that we nurture students' "genuine or intrinsic interests". These subjective knowers have probably not experienced validation of their knowledge in traditional school settings. Nurture of these personal interests might also support students' pursuits of nontraditional scientific knowledge forms. They might then be able to integrate or find ways of coexisting with the power of their personal knowledge along with other forms of scientific knowledge.

Making real-world connections is not a new finding in educational research. Yet the large number of subjective knowers and the lack of formal scientific information as an ultimate source of knowledge seen in this study seem to indicate that many students are not making the connection between their science classes and everyday lives. This may be an indicator of the gulf between research and practice. Instructors may not be explicating real life applications, or students are not tuned in to the connections teachers are attempting. The communication gap between researchers and practitioners may also be occurring between practitioners and students.

The intensity of the voices in this study indicates that the commitment by students to meaningful science is possible even if at this time it is somewhat misdirected by nonscientific sources. Finding ways to make multiple scientific sources readily available to students is key to their redirection. Studying the success of constructive knowers may give clues. Real-world connection was certainly evident here along with teacher support and encouragement in personal applications by students.

The overwhelming interest in human responsibility agendas is another point worth considering. Appealing to human responsibility may be a way to make science accessible to students who have been outsiders to the science community. However, we must also consider ways to broaden students' scientific scope to include utility, appreciation and criticism of science.

With a great deal of emphasis on elementary science in current reforms, it is important to learn more about elementary teachers themselves, many of whom have been outsiders to science. Feminist methodologies and critiques of science can help us to better understand the positions of some preservice elementary teachers and provide us with concrete pedagogies. As

prospective elementary teachers are directed to know their students, so must we understand and support them in order to make science approachable and meaningful for all.

References

Abell, S.K. & Smith, D. C. (1994). What is science?: Preservice elementary teachers' conceptions of the nature of science. *International Journal of Science Education, 16 (4),* 475-487.

Belenky, M.F., Clinchy, B. M., Goldberger, N. R., & Tarule, J.M. (1986). *Women's ways of knowing: The development of self, voice, and mind.* New York: Basic Books, Inc.

Harding, S. (1986). *The science question in feminism.* Ithaca, NY: Cornell University Press.

Hubbard, R. & Randall, M. (1988). *The shape of red: Insider/outsider reflections.* San Francisco, CA: Cleis Press.

Keller, E.F. (1985). *Reflections on gender and science.* New Haven, CT: Yale University Press.

Noddings, N. (1992). *The challenge to care in schools: An alternative approach to education.* New York: Teachers College Press.

Perry, W.G. (1970). *Forms of intellectual and ethical development in the college years.* New York: Rinehart & Winston.

Posner, G., Strike, K., Hewson, P., & Gertzog, W. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education, 66,* 211-227.

Rosser, S.V. (1990). *Female-friendly science: Applying women's studies methods and theories to attract students.* New York: Pergamon Press.

Strike, K., and Posner, G. (1992). "A revisionist theory of conceptual change." In Richard A. Duschl and Richard J. Hamilton (Eds.), *Philosophy of science, cognitive psychology, and educational theory and practice.* Albany, NY: State University of New York Press, 147-176.

Tannen, D. (1990). *You just don't understand.* New York: Ballantine Books.